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Description

Long stator motor

The invention relates to a long stator motor, in particular for driving a magnetic levitation railroad, having a stator iron in which slots are arranged for holding cable windings.

A long stator motor such as this, which is also referred to as a linear motor, generally has two or more stator coils. Each stator coil comprises a stator iron in which slots are incorporated, and cable windings which run in these slots. In the case of a three-phase motor, the three cable windings for the three phases, and thus the slots which are required for this purpose as well, run offset with respect to one another.

Particularly during starting of a vehicle which is driven by a long stator motor, the magnetic flux to be achieved by the known apparatus in the stator iron is not sufficient in order to achieve the desired vehicle acceleration. This is mainly due to the fact that the cable windings cannot withstand the current level that is required for a sufficiently high magnetic flux. The current level cannot be increased since this would otherwise result in an excessively large thermal load on the stator coil. On the other hand, the cable cross section cannot be enlarged in order to increase the possible current level since broader slots will make it impossible to arrange the slots for three cable windings, as are required for a three-phase motor. Furthermore, no more suitable materials are known for the stator iron which could allow a greater magnetic flux with the same current level.

The invention is based on the object of specifying a long stator motor which allows a considerably higher magnetic flux in the stator iron, thus allowing greater acceleration

of the driven vehicle, which is of major importance, particularly in the starting phase.

According to the invention, the object is achieved in that at least two cable windings are arranged one above the other, in that at least two cables run in each slot.

In particular, two cable windings are arranged one above the other, and two cables run in each slot.

It has been found that the stator iron allows the slots to be made deeper without any problems. Two or more layers of cable windings, in particular two layers, an upper layer and a lower layer, can then be inserted one above the other into the slots. The cables of the cable windings in this case have the same cross sections as in the case of known solutions.

This results in the advantage that, even though the slots have the same width as in the past, and without any noticeable temperature increase in comparison to known solutions, it is possible to considerably increase the magnetic flux in the stator iron. This results in greater acceleration than with known long stator motors, which is particularly important during starting of a vehicle.

This is because higher vehicle acceleration values advantageously make it possible to shorten the intervals between trains.

The cables can be laid using standard laying methods.

By way of example, three cable windings are in each case arranged in one layer as a three-phase winding, and the layers formed in this way are arranged one above the other. This results in an advantageous geometric arrangement of the cable windings.

By way of example, the cables which run in one slot are connected to the same phase of the three-phase windings. This results in a particularly uniform magnetic flux in the stator iron.

By way of example, the three-phase windings are connected in series. This results in the advantage that all the cable windings contribute optimally to the magnetic flux and an increased voltage is applied to the motor, thus making better use of a converter which feeds the motor.

According to another example, the three-phase windings are connected in parallel.

Two three-phase windings which are arranged one above the other are in each case offset, for example, through 180° with respect to one another. This results in the advantage that the crossing points of these windings are not positioned at the same point on the stator iron. This results in a shallower slot depth than otherwise. If only two windings are arranged one above the other, the slot does not need to be deeper than three cable cross sections.

The long stator motor according to the invention results in particular in the advantage that high acceleration values can be achieved for the driven vehicle, which in particular may be a transrapid, without the thermal load on the long stator motor becoming excessive. A magnetic flux which is sufficient for the desired acceleration is achieved in the stator iron without adversely affecting the robustness of the stator iron or necessitating a very large, heavy stator iron. The entire stator iron generally does not need to be any thicker than three cable cross sections.

One exemplary embodiment of a long stator motor according to the invention will be explained in more detail with reference to the drawing. The

drawing shows, schematically, the arrangement of cable windings on a stator iron.

The stator iron 1, which is illustrated in the form of a section, has a sequence of slots 2. These slots 2 are used to hold cable windings 3 to 8. Until now, it has been normal for the slots 2 of a stator iron 1 to hold only three cable windings 3 to 5 of a three-phase system. These cable windings 3 to 5 each run through every third slot 2, so that the individual cable windings are distributed uniformly.

In the case of the long stator motor according to the exemplary embodiment of the invention, three further cable windings 6 to 8 are laid in the same slots 2. The cable windings 3 to 5 which were mentioned first in this case form a first layer, while the further cable windings 6 to 8 form a second layer. The slots 2 need be no broader than in the known embodiment, but need only be deeper. This does not adversely affect the robustness of the stator iron 1. Broader slots 2 would not be feasible, for space reasons. The further cable windings 6 to 8 are laid relative to the first-mentioned cable windings 3 to 5 such that two cables come together in each individual slot 2 and are associated with the same phase of the respective three-phase winding or layer.

The two three-phase windings or layers, comprising on the one hand the first-mentioned three cable windings 3 to 5 and on the other hand the further three cable windings 6 to 8, are connected to one another either in series or in parallel. This circuitry measure is not illustrated in the drawing.

The long stator motor according to the invention does not require any broader slots 2, for which no space would be available anyway. Furthermore, this avoids thermal loading which would be unavoidable simply by increasing the current level. A magnetic flux can be produced easily and

reliably which is sufficiently large to achieve greater acceleration of the driven vehicle, in particular during starting. This allows a higher train throughput rate.